Claims

1. An optical module comprising:

a light-emitting device configured to output a laser beam;

a first temperature-sensing unit disposed adjacent to the light-emitting device so as to sense a temperature of said light-emitting device;

an optical filter positioned to receive and filter at least a component of the laser beam;

a wavelength monitor device configured to monitor a wavelength of the laser beam and output a signal associated with monitored light at the wavelength;

a wavelength regulating unit configured to regulate the wavelength of the laser beam that is output from said light-emitting device based on said signal from the wavelength monitor device;

a second temperature-sensing unit disposed adjacent to said optical filter so as to sense a temperature of said optical filter; and

a temperature control unit configured to regulate the temperature in at least one of said light-emitting device and said wavelength monitor device, wherein

at least a portion of said wavelength monitor device being in contact with said temperature control unit.

2. The optical module as defined in claim 1, wherein:

the temperature control unit is configured to separately regulate the temperature of the light-emitting device and the temperature of the optical filter.

3. The optical module as defined in claim 1, wherein:

said second temperature-sensing unit being in contact with said optical filter.

4. The optical module as defined in claim 1 wherein:

said wavelength regulating unit is configured to regulate the wavelength of said laser beam by regulating the temperature of said light-emitting device.

5. The optical module as defined in claim 1 wherein:

said wavelength monitor device comprises

a beam splitter configured to divide said laser beam into two laser beam components, and

two photo detectors each positioned to receive respective of the two laser beam components and each configured to photo electrically transform each component into respective electric signals which form said signal that is output from said wavelength monitor device, wherein

said optical filter is disposed between at least one of said two photo detectors and the beam splitter.

6. The optical module as defined in claim 4, wherein:

said wavelength monitor device comprises

a beam splitter configured to divide said laser beam into two laser beam components, and

two photo detectors each positioned to receive respective of the two laser beam components and photo electrically transform each component into respective electric signals which form said signal that is output from said wavelength monitor device, wherein

said optical filter is disposed between at least one of said two photo detectors and the beam splitter.

7. The optical module as defined in claim 6, wherein:

said beam splitter is a prism.

8. The optical module as defined in claim 6, wherein:

said prism includes two faces oriented at respective predetermined angles with respect on an optical axis of the prism.

9. The optical module as defined in claim 1, wherein:

said optical filter is a Fabry-Perot etalon filter that exhibits a cyclic wavelength-transmission characteristic with a wavelength spacing for each cycle being equal to or smaller than a spacing that corresponds to a frequency of 100 GHz.

10. The optical module as defined in claim 1, wherein:

said wavelength regulating unit is adapted to lock the wavelength of the laser beam at a predetermined wavelength based on the signal from said wavelength monitor device after the wavelength monitor device regulates the wavelength of the laser beam to fall within a wavelength range based on a first temperature signal that is produced from said first temperature-sensing unit, and

the second temperature-sensing unit is configured to produce a second temperature signal that is used by said wavelength regulating unit to correct any deviation in the locked wavelength associated with a temperature characteristic of said optical filter.

11. The optical module as defined in claim 10, wherein:

both the first temperature-sensing unit and the second temperature-sensing unit are configured to share a common terminal.

12. The optical module as defined in claim 11, further comprising:

a butterfly package having 14 pins, said common terminal being connected to one of said 14 pins.

13. The optical module as defined in claim 1, wherein:

a surface of said optical filter has a metallic electric wiring pattern; and

said second temperature-sensing unit is mounted on said metallic pattern.

14. The optical module as defined in claim 1, wherein:

said wavelength monitor device includes a filter holder formed of a heat conductive material;

said optical filter is fixedly mounted to said filter holder; and

said second temperature-sensing unit is mounted adjacent to said optical filter on said filter holder.

15. The optical module as defined in claim 1, wherein:

said second temperature-sensing unit is disposed between a top face and a bottom face of said optical filter.

16. The optical module as defined in claim 1, further comprising:

a package that houses said light-emitting device, wavelength monitor device and wavelength regulating unit, wherein

said second temperature-sensing unit is disposed between said optical filter and one side of the package.

17. The optical module as defined in claim 14, wherein:

said filter holder includes

a first mount section on which said optical filter is mounted, and

a second mount section integrally formed with said first mount section and adapted to position said second temperature-sensing unit at an intermediate position between a bottom face and a top face of said optical filter.

18. The optical module as defined in claim 17, wherein:

the second mount section of said filter holder has a gold plated layer on which the second mount section is soldered to said second temperature-sensing unit.

19. The optical module as defined in claim 14, wherein:

said second temperature-sensing unit is fixedly bonded to said filter holder.

20. The optical module as defined in claim 1, further comprising:

a filter holder on which said optical filter is disposed, said filter holder includes a gold plated strut configured to control placement of wires within the optical module.

21. An optical transmitter comprising:

an optical module having

a light-emitting device configured to output a laser beam,

a first temperature-sensing unit disposed adjacent to the light-emitting device so as to sense a temperature of said light-emitting device,

an optical filter positioned to receive and filter at least a component of the laser beam,

a wavelength monitor device configured to monitor a wavelength of the laser beam and output a signal associated with the wavelength,

a wavelength regulating unit configured to regulate the wavelength of the laser beam that is output from said light-emitting device based on said signal,

a second temperature-sensing unit disposed adjacent to said optical filter so as to sense a temperature of said optical filter, and

a temperature control unit configured to regulate the temperature in at least one of said light-emitting device and said wavelength monitor device, wherein at least a portion of said wavelength monitor device being in contact with said temperature control unit;

a control unit configured to fix the wavelength of the laser beam outputted from said light-emitting device at a predetermined locked wavelength, based on the signal outputted from said wavelength monitor device; and

a correcting unit configured to output a correction signal to said control unit based on a temperature sensed by said second temperature-sensing unit, said correction signal being operative to command a correction of any deviation in said locked wavelength associated with a temperature characteristic of said optical filter.

22. The transmitter as defined in claim 21, wherein:

said wavelength regulating unit is adapted to regulate the wavelength of said light-emitting device by regulating a temperature of said light-emitting device.

23. The transmitter as defined in claim 21, wherein:

said wavelength regulating unit is adapted to regulate the wavelength in said light-emitting device by regulating a current injected into said light-emitting device.

24. The transmitter as defined in claim 23, further comprising:

an optical output monitoring unit configured to monitor an optical output of

the laser beam output from said light-emitting device; and

an optical attenuation regulating unit configured to control said optical output to be constant, based on the optical output monitored by said optical output monitoring unit.

25. The transmitter as defined in claim 21, wherein:

said wavelength monitor device comprises

a beam splitter configured to divide said laser beam into two laser beam components, and

two photo detectors each positioned to receive respective of said two laser beam components and each configured to photo electrically transform each component into respective electric signals which form the signal that is output from said wavelength monitor device, wherein

said optical filter is disposed between at least one of said two photo detectors and the beam splitter.

26. The transmitter as defined in claim 21, wherein:

said control unit comprises

two transformers configured to transform respective currents from first said two photo detectors into corresponding voltage signals,

a comparator configured to compare said corresponding voltage signals with each other and output at least one of a difference and a ratio between said corresponding voltage signals as a control signal, and

a current generator that is configured to output a temperature control current for the temperature control unit so as to regulate the temperature in the at least one of the light-emitting device and the wavelength monitoring device based on the control signal from said comparator.

27. The transmitter as defined in claim 21, wherein:

said correcting unit is configured to correct the deviation in said locked wavelength associated with the temperature characteristic of said optical filter by applying a predetermined voltage corresponding to the temperature of said optical

filter to said control unit so as to offset a voltage signified in said control signal by said predetermined voltage.

28. The transmitter as defined in claim 21, further comprising:

an injection current control unit configured to receive a signal outputted from a power monitor photo detector that receives the laser beam from said light-emitting device, and said injection current control unit configured to control a current injected into said light-emitting device, based on the signal outputted from the power monitor photo detector.

29. The transmitter as defined in claim 28, wherein:

said wavelength monitor device includes said power monitor photo detector to produce said signal associated with said wavelength.

30. The transmitter as defined in claim 25, wherein:

said control unit includes an analog/digital converter that converts the electric signals outputted from said two photo detectors into digital signals.

31. The transmitter as defined in claim 30, wherein:

optical filter has a predetermined thermistor resistance; and

said control unit is configured to vary a photo diode current ratio of currents output from the two photo diodes via a linear relationship with said thermistor resistance so as to compensate for temperature dependent wavelength drift of said laser beam.

32. The transmitter as defined in claim 21, wherein:

said correcting unit includes a variable attenuator that is controllably configured to adjust a signal level output of said optical filter.

33. The transmitter as defined in claim 32, wherein:

said correcting unit includes an optical-output detecting unit that detects the signal level of the signal from the optical filter and adjusts an amount of attenuation

from said variable attenuator so as to control an output level from the variable attenuator.

34. A WDM transmitting device comprising:

a plurality of optical transmitting devices configured to output to a common optical fiber respective optical signals at different wavelengths, each of said plurality of optical transmitting devices including

an optical module having

a light-emitting device configured to output a laser beam,

a first temperature-sensing unit disposed adjacent to the light-emitting device so as to sense a temperature of said light-emitting device,

an optical filter positioned to receive and filter at least a component of the laser beam,

a wavelength monitor device configured to monitor a wavelength of the laser beam and output a signal associated with the wavelength,

a wavelength regulating unit configured to regulate the wavelength of the laser beam that is output from said light-emitting device based on said signal,

a second temperature-sensing unit disposed adjacent to said optical filter so as to sense a temperature of said optical filter, and

a temperature control unit configured to regulate the temperature in at least one of said light-emitting device and said wavelength monitor device, wherein at least a portion of said wavelength monitor device being in contact with said temperature control unit;

a control unit configured to fix the wavelength of the laser beam outputted from said light-emitting device at a predetermined locked wavelength, based on the signal outputted from said wavelength monitor device; and

a correcting unit configured to output a correction signal to said control unit based on a temperature sensed by said second temperature-sensing unit, said correction signal being operative to command a correction of any deviation in said locked wavelength associated with a temperature characteristic of said optical filter.

35. The WDM transmitting device as defined by claim 34, further comprising:

a multiplexer configured to multiplex the respective optical signals into the common optical fiber.

36. An optical module comprising:

a light-emitting device configured to output a laser beam, said light-emitting device being positioned at a first location;

means for sensing a temperature of said light-emitting device;

means for monitoring a wavelength of the laser beam at a second location and for outputting a signal indicative of the wavelength, said second location being different than said first location;

means for regulating the wavelength of the laser beam that is output from said light-emitting device based on said signal;

means for sensing a temperature at said second location; and

means for regulating the temperature in at least one of said first location and said second location.

37. The optical module as defined in claim 36, wherein:

said means for regulating includes means for regulating the temperature at said first location and regulating the temperature at the second location.

38. The optical module as defined in claim 37, wherein:

said means for regulating takes into account an amount of temperature regulation applied at said first location when determining an amount of temperature regulation to be applied at said second location.

39. The optical module as defined in claim 36, wherein:

said means for regulating includes means for locking a wavelength of the laser beam produced by said light emitting device by accounting for both an operating temperature of the light emitting device and temperature-dependent characteristics of an optical component used by said means for monitoring.

40. An optical transmitter comprising:

an optical module having

a light-emitting device configured to output a laser beam, said light-emitting device being positioned at a first location,

means for sensing a temperature of said light-emitting device,

means for monitoring a wavelength of the laser beam at a second

location and for outputting a signal indicative of the wavelength, said second location being different than said first location,

means for regulating the wavelength of the laser beam that is output from said light-emitting device based on said signal,

means for sensing a temperature at said second location, and

means for regulating the temperature in at least one of said first location and said second location; and

means for fixing the wavelength of the laser beam outputted from said light-emitting device at a predetermined locked wavelength, based on the signal outputted from said means for monitoring; and

means for outputting a correction signal to said means for fixing based on the temperature sensed by said means for sensing a temperature at said second location, said correction signal being operative to command a correction of any deviation in said predetermined locked wavelength associated with a temperature characteristic of an optical component used in said means for monitoring.

41. The optical transmitter as defined in claim 40, wherein:

said means for regulating includes means for regulating the temperature at said first location and regulating the temperature at the second location.

42. The optical transmitter as defined in claim 41, wherein:

said means for regulating takes into account an amount of temperature regulation applied at said first location when determining an amount of temperature regulation to be applied at said second location.

43. The optical transmitter as defined in claim 40, wherein:

said means for regulating includes means for locking a wavelength of the laser beam produced by said light emitting device by accounting for both an operating temperature of the light emitting device and temperature-dependent characteristics of an optical component used by said means for monitoring.

44. A WDM transmitting device comprising:

a plurality of optical transmitting devices configured to output to a common optical fiber respective optical signals at different wavelengths, each of said plurality of optical transmitting devices including

an optical module having

a light-emitting device configured to output a laser beam, said light-emitting device being positioned at a first location,

means for sensing a temperature of said light-emitting device,

means for monitoring a wavelength of the laser beam at a second location and for outputting a signal indicative of the wavelength, said second location being different than said first location,

means for regulating the wavelength of the laser beam that is output from said light-emitting device based on said signal,

means for sensing a temperature at said second location, and

means for regulating the temperature in at least one of said first location and said second location; and

means for fixing the wavelength of the laser beam outputted from said light-emitting device at a predetermined locked wavelength, based on the signal outputted from said means for monitoring; and

means for outputting a correction signal to said means for fixing based on the temperature sensed by said means for sensing a temperature at said second location, said correction signal being operative to command a correction of any deviation in said predetermined locked wavelength associated with a temperature characteristic of an optical component used in said means for monitoring.

45. The WDM transmitting device as defined in claim 44, wherein:

said means for regulating includes means for regulating the temperature at said first location and regulating the temperature at the second location.

46. The WDM transmitting device as defined in claim 45, wherein:

said means for regulating takes into account an amount of temperature regulation applied at said first location when determining an amount of temperature regulation to be applied at said second location.

47. The WDM transmitting device as defined in claim 44, wherein:

said means for regulating includes means for locking a wavelength of the laser beam produced by said light emitting device by accounting for both an operating temperature of the light emitting device and temperature-dependent characteristics of an optical component used by said means for monitoring.

48. A method for stabilizing a wavelength of a laser beam output from a light-emitting device, comprising steps of:

outputting a laser beam from the light-emitting device, said light-emitting device being positioned at a first location;

sensing a temperature of said light-emitting device;

monitoring a wavelength of the laser beam at a second location and outputting a signal indicative of the wavelength, said second location being different than said first location;

regulating the wavelength of the laser beam that is output from said light-emitting device based on said signal;

sensing a temperature at said second location; and

regulating the temperature in at least one of said first location and said second location.

49. The method defined by claim 48, wherein:

said regulating step includes regulating the temperature at said first location and regulating the temperature at the second location.

50. The method defined by claim 49, wherein:

regulating step includes taking into account an amount of temperature regulation applied at said first location when determining an amount of temperature regulation to be applied at said second location.

51. The method defined by claim 48, wherein:

regulating step includes locking a wavelength of the laser beam produced by

said light emitting device by accounting for both an operating temperature of the light emitting device and temperature-dependent characteristics of an optical component used in said monitoring step.